Verification of Monte Carlo Calculations by means of Neutron and Gamma Fluence Spectra Measurements behind and inside of Iron-Water Configurations

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Gamma spectrum measurements in neutron-gamma reactor environments, suitable to test coupled neutron-gamma transport calculations, are very rare or not available at all. Considering recent findings on possible gamma-induced radiation damage in the pressure vessel region and the following new interest in gamma fluence spectra, a new neutron-gamma experiment has been realized. At the zero-power research reactors AKR of the Technical University Dresden and the ZLFR of the University of Applied Sciences Zittau/Goerlitz neutron and gamma spectra have been measured behind and inside of transmission modules consisting of variable iron and water slabs*). The calibrated NE213 scintillation spectrometer allowed the simultaneous measurement of absolute gamma and neutron fluence spectra in the energy range 0.5 - 10 MeV for photons and 1.0 - 10 MeV for neutrons. The reactor power was determined with the help of in-core activation and fission detector measurements and their Monte Carlo simulation.

With main emphasis on the gamma radiation, the results of gamma and neutron fluence measurements were compared with Monte Carlo calculation results. In a first step, absolute neutron source distributions were calculated by normalizing MCNP calculation results by in-core detector measurements. Using the neutron sources and the reactor power history the gamma source distributions in the core were obtained. Based on the resulting absolute neutron and gamma source distributions neutron and gamma fluence spectra integrated over the NE213 detector volume were calculated by means of the codes TRAMO and MCNP using ENDF/B-VI and other nuclear data files. The comparison of results of both codes, of results obtained with different evaluated libraries and of calculated results with experimental data, aims at the estimation of the uncertainties of up-to-date neutron-gamma calculation methods and associated nuclear data libraries.

*) B. Boehmer et al., Proc. of ND2001, Journ. Nucl. Sci. Technol. (JNST), Suppl. 2, Vol. 2, p. 947-950 (August 2002)

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